

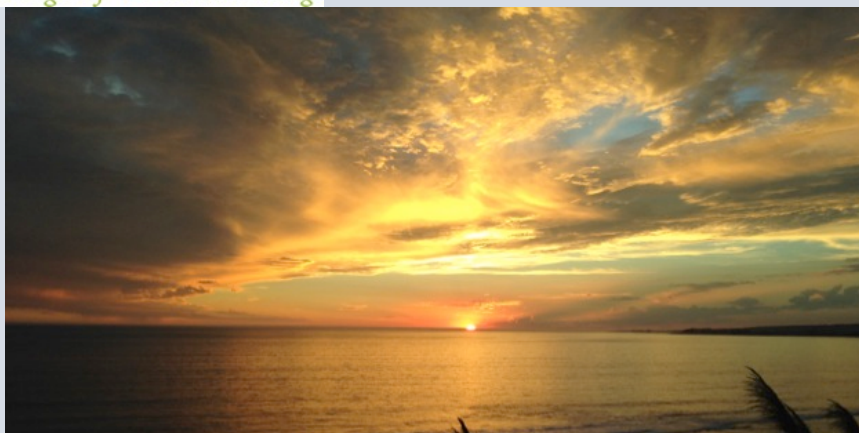


# Climate Change Adaptation

## What it means for you and your work



Lara J. Hansen, Ph.D.  
Chief Scientist & Executive Director  
EcoAdapt





“There is no box.”

*-Amory Lovins*



# Definitions

**Mitigation:** Reducing the causes of climate change

**Adaptation:** Responding to, preparing for and when possible reducing, the effects of climate change  
(*Buying Time*)

“The future ain’t what it  
used to be.”

*-Yogi Berra*

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“Don’ t Panic.”

*-Douglas Adams*  
Hitchhiker’ s Guide to the Galaxy

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# Vulnerability



## Adaptation Options



**Resistance**



**Resilience**



**Response**

# Five tenets of adaptation

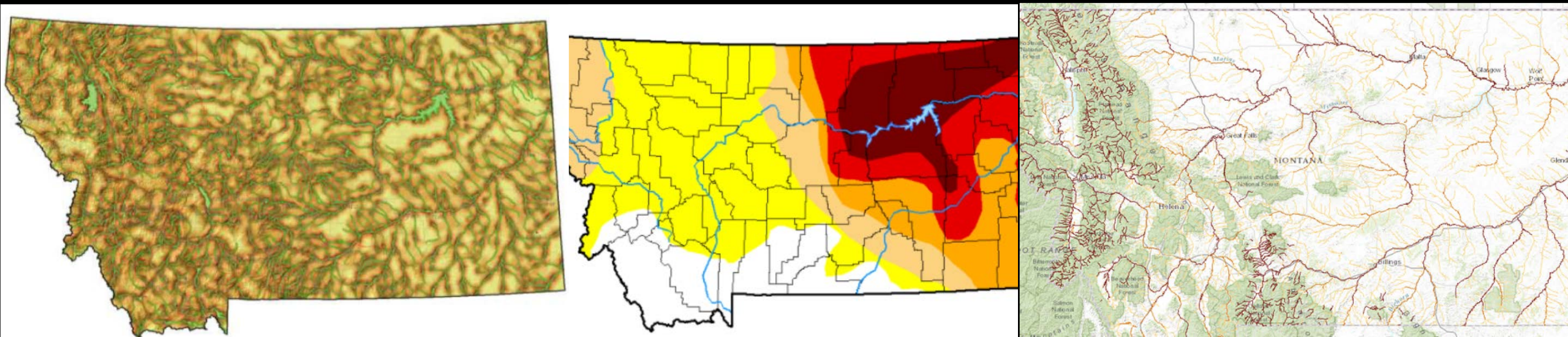
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# 1) Protect adequate and appropriate space for a changing world

## *Spatial Considerations Require Temporal/Climate Aware Thinking*

- Refugia
- Gradients (Latitudinal/Elevational)
- Heterogeneity
- Gene flow/Connectivity
- Inclusion of other changes in larger watershed or landscape





## 2) Reduce non-climate stresses

WhiteMountainHistory.org



Unsustainable  
Harvest



Agriculture & Habitat  
Fragmentation



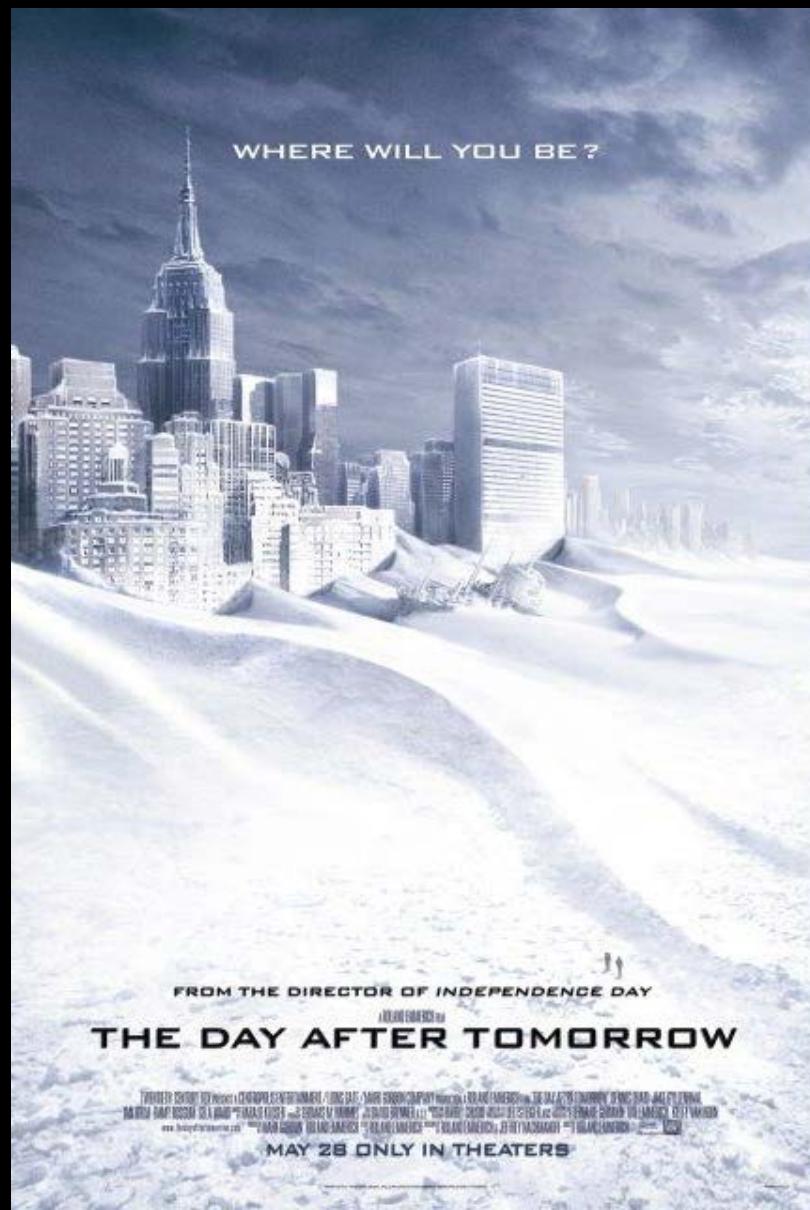
Invasive & Pest  
Species



Pollution &  
Habitat Degradation



### 3) Manage for Uncertainty





## 4) Reduce local and regional climate change





## 5) Reduce Greenhouse Gas Emissions



**Resilience options have limits, some systems are very limited**

**High elevation habitat, polar landscapes, oceans, drier regions....**





Does a skateboard company have a better adaptation plan than your community or agency?





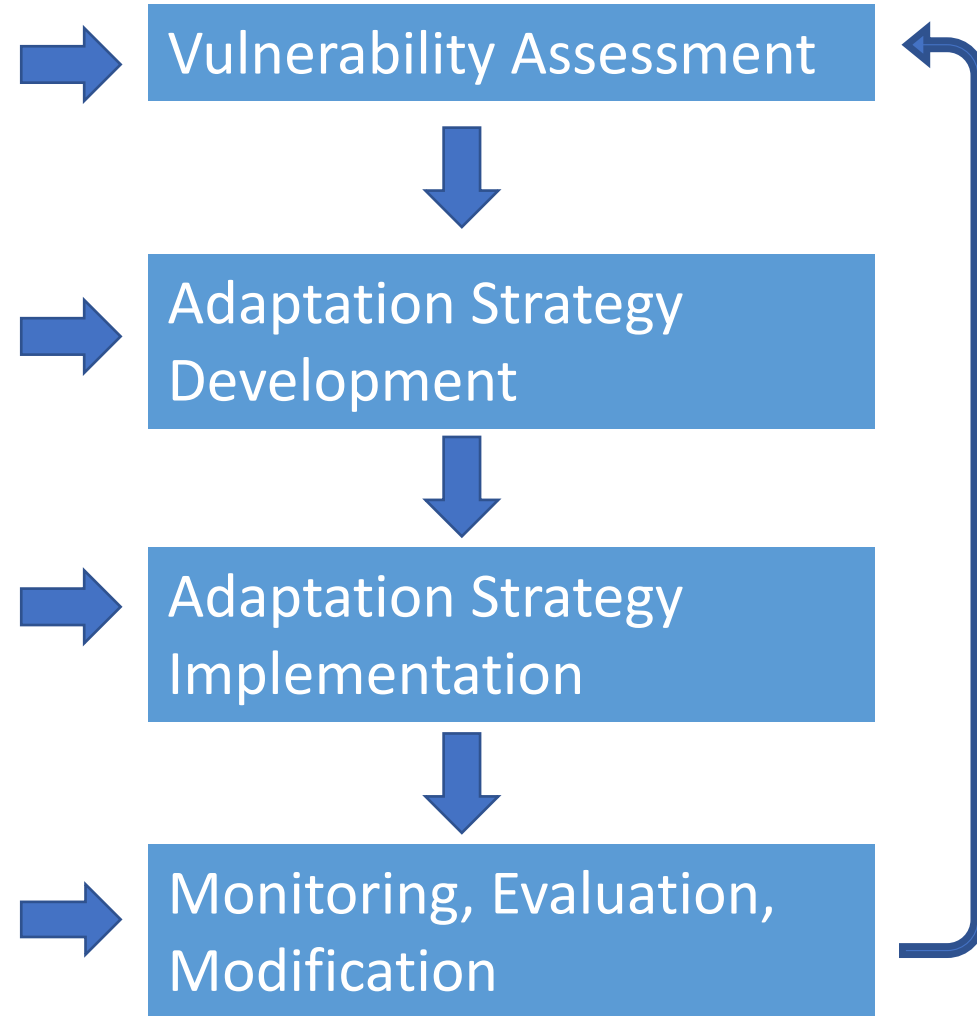
# Adaptation Process

Understand implications of climate change for water and water dependent resources

Design water management and water related practices to develop *durable* outcomes

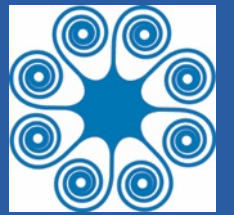
Improve water management and water related practices to achieve *durable* outcomes

Determine the efficacy of water management and water related practices as conditions change





# Towards Adaptation Action



## A THREE-STEP DECISION SUPPORT FRAMEWORK FOR CLIMATE ADAPTATION:

**Selecting Climate-Informed Conservation  
Goals and Strategies for Native Salmonids  
in the Northern U.S. Rockies**



THE CENTER FOR  
LARGE LANDSCAPE  
CONSERVATION



Funding provided by:



*Using information on  
climate vulnerabilities  
to select goals and  
actions from a menu of  
adaptation options*

Funding from:





# 3 Step Decision Support Framework



## Step 1: Vulnerability

## Step 2: Adaptation Strategy

## Step 3: Implementation Actions

### STEP 1: Assess Vulnerability of Selected Native Salmonid Population to Climate Change

For all questions, document your assumptions (i.e., which species you are choosing for what stream temperature thresholds you are using, which models or empirical analyses you are using, etc.).

Key Factor of Vulnerability	HABITAT SUITABILITY To what extent will the habitat be suitable for native salmonid conservation?
Are stream temperatures likely to increase or decrease?	• Are stream temperatures likely to increase or decrease?
Are any other key habitat resources (e.g., spawning habitat, cover, etc.) likely to be affected?	• Are any other key habitat resources (e.g., spawning habitat, cover, etc.) likely to be affected?
Are climate-driven changes (e.g., increased streamflow, increased sedimentation, etc.) likely to affect the habitat?	• Are climate-driven changes (e.g., increased streamflow, increased sedimentation, etc.) likely to affect the habitat?
Is the population more resilient to the conditions (i.e., less likely to be affected) than other populations?	• Is the population more resilient to the conditions (i.e., less likely to be affected) than other populations?
Could climate-driven changes (e.g., increased streamflow, increased sedimentation, etc.) be managed or mitigated?	• Could climate-driven changes (e.g., increased streamflow, increased sedimentation, etc.) be managed or mitigated?
Answer: <b>A</b>	

**Climate Change Vulnerability Factors**

**Habitat Suitability**

**Threats from non-native fish**

**Connectivity**

**Answer: A**

If you answered: Go to Box:  
A B F 1  
A D G 2  
A E F 3  
A E G 4

Go to STEP 2 to find suggestions on potential goals and strategies for your population of interest.

### STEP 2: Use Vulnerability Matrix to Clarify Management Goals and Select Climate Adaptation Strategies

	HABITAT REMAINS OR BECOMES SUITABLE	HABITAT BECOMES MARGINAL	HABITAT BECOMES UNSUITABLE
LOW THREAT FROM NON-NATIVE FISH	<b>Relative vulnerability to climate change:</b> Low <b>Relative value for native salmonid conservation:</b> High value in both the short and long term <b>Potential Goal:</b> Protect and maintain (or improve if warranted) this habitat network for long-term conservation of native salmonids <b>Strategies:</b> <ul style="list-style-type: none"><li>• Protect climate refugia</li><li>• Protect existing networks</li><li>• Expand/rebound populations</li><li>• Prevent invasion of non-native fish</li></ul>	<b>Relative vulnerability to climate change:</b> Medium <b>Relative value for native salmonid conservation:</b> Potential value over the long term, but will likely require investment to moderate climate impacts <b>Potential Goal:</b> Improve the suitability of this habitat network for long-term conservation of native salmonids <b>Strategies:</b> <ul style="list-style-type: none"><li>• Moderate stream temperature increases</li><li>• Moderate peak flow decreases</li><li>• Moderate peak flow increases</li><li>• Increase adaptive capacity of native fish</li><li>• Minimize adverse impacts in the event of potential increased wildfire disturbance</li><li>• Protect existing networks</li><li>• Reduce uncertainty through research and monitoring</li><li>• Prevent invasion of non-native fish</li></ul>	<b>Relative vulnerability to climate change:</b> Medium-High <b>Relative value for native salmonid conservation:</b> Potential value in the short term to help with population recovery, maintenance of genetic diversity and/or local adaptations. Long-term value is lower due to decreasing habitat suitability <b>Potential Goal:</b> Maintain population in the short term. In the longer term, consider facilitating the movement of current population to other locations with more suitable conditions, facilitating the transition of the location to a new state, and/or managing the location for other targets (e.g., game fish or non-fish targets) <b>Strategies:</b> <ul style="list-style-type: none"><li>• Reduce uncertainty through research and monitoring</li><li>• Increase adaptive capacity of native fish</li><li>• Relocate individuals to areas likely to remain or become suitable</li><li>• Facilitate transition to a new state</li></ul>
POPULATION IS CONNECTED TO LARGER NETWORK	<b>Relative vulnerability to climate change:</b> Medium-Low <b>Relative value for native salmonid conservation:</b> High value in both the short and long term, but may require investment to prevent/reduce suppression of non-native fish <b>Potential Goal:</b> Prevent invasion of non-native fish for removal (suppression if already present), and protect and maintain (or improve if warranted) this habitat network for long-term conservation of native salmonids <b>Strategies:</b> <ul style="list-style-type: none"><li>• Remove (suppress) non-native fish</li><li>• Prevent invasion of non-native fish</li><li>• Expand/rebound populations</li><li>• Protect existing networks</li><li>• Protect climate refugia</li></ul>	<b>Relative vulnerability to climate change:</b> Medium-High <b>Relative value for native salmonid conservation:</b> Potential value over the long term, but will require a high-level of investment to both moderate climate impacts and prevent/reduce suppression of non-native fish <b>Potential Goal:</b> Prevent invasion of non-native fish for removal (suppression if already present), and improve the suitability of this habitat network for long-term conservation of native salmonids <b>Strategies:</b> <ul style="list-style-type: none"><li>• Moderate stream temperature increases</li><li>• Moderate peak flow decreases</li><li>• Moderate peak flow increases</li><li>• Increase adaptive capacity of native fish</li><li>• Remove (suppress) non-native fish</li><li>• Prevent invasion of non-native fish</li><li>• Minimize adverse impacts in the event of potential increased wildfire disturbance</li><li>• Protect existing networks</li><li>• Reduce uncertainty through research and monitoring</li></ul>	<b>Relative vulnerability to climate change:</b> High <b>Relative value for native salmonid conservation:</b> Potential value in the short term to help with population recovery, maintenance of genetic diversity and/or local adaptations, but will require investment to prevent/reduce suppression of non-native fish. Long-term value is lower due to decreasing habitat suitability <b>Potential Goal:</b> Facilitate the movement of current population to other locations with more suitable conditions; facilitate the transition of the location to a new state. Consider managing the location for other targets (e.g., game fish or non-fish targets) <b>Strategies:</b> <ul style="list-style-type: none"><li>• Reduce uncertainty through research and monitoring</li><li>• Relocate individuals to areas likely to remain or become suitable</li><li>• Facilitate transition to a new state</li><li>• Determine additional strategies after clarifying management goal(s)</li></ul>
HIGH THREAT FROM NON-NATIVE FISH			

STEP 2 continues on the following page or go to STEP 3 for more information about strategies and their Example Actions.

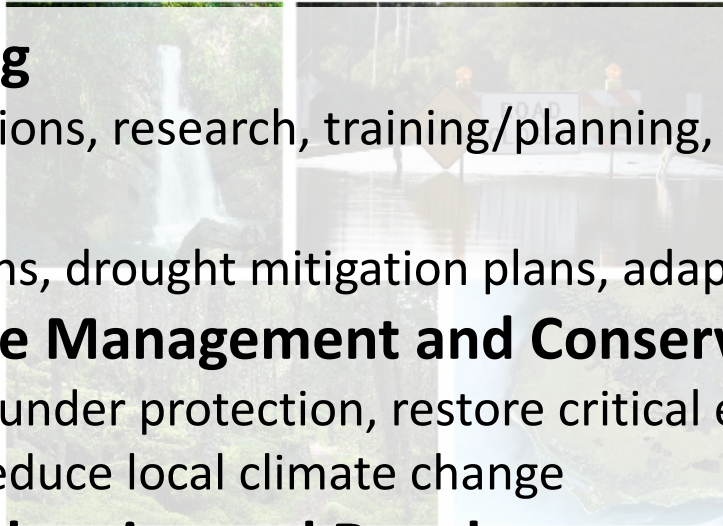
### STEP 3: Select Actions to Implement Chosen Climate Adaptation Strategies (cont.)

Strategy	Objective	Example Actions
Moderate peak flow increases	Restore floodplain connections	• Remove infrastructure (e.g., roads, ditches, rip-rap, etc.) from floodplains • Reconnect floodplain features (e.g., channels, ponds) • Create new or restore degraded floodplain habitats
	Restore incised (scoured) channels	• Reintroduce beaver to encourage dam-building that increases sediment storage and deposition • Establish riparian vegetation, remove non-native vegetation • Remove stressors that cause riparian damage (illegal or degraded trails, cattle, etc.)
	Restore riparian vegetation	• Establish riparian vegetation, remove non-native vegetation • Remove stressors that cause riparian damage (illegal or degraded trails, cattle, etc.)
	Restore stream flow regimes	• Disconnect road drainage from streams • Remove or retrofit undersized culverts • Restore natural drainage systems, create wetland ponds
	Reduce rain-on-snow flooding	• Maintain/restore forest, wetland and riparian vegetation cover
Moderate stream temperatures increases	Connect populations to cold-water (stream networks)	• Remove dams or culverts that act as barriers and limit fish access to cold-water streams • Restore (provide) in-stream flows • Restore thermal barriers
	Reconnect floodplains	• Reconnect floodplain features (e.g., side channels, ponds) • Designate and restore natural floodplain boundaries • Remove infrastructure (e.g., roads, ditches, rip-rap, etc.) from floodplains
	Restore incised (scoured) channels	• Reintroduce beaver or build beaver dams/uplogs to increase sediment storage • Restore riparian vegetation • Remove stressors that cause riparian damage (illegal or degraded trails, cattle, etc.)
	Restore stream flows	• Work to restore natural flow regimes • Reduce water withdrawal, restore summer baseflow • On regulated streams, pull flow during critical times, sourcing from lower in the thermocline
	Maintain/enhance riparian vegetation to shade streams	• Reduce grazing pressure (e.g., reduce stocking rates, use rest-rotation systems, fence riparian areas, provide off-stream water sources, enter vacant allotments in priority fish areas, increase monitoring in priority areas to ensure good practices) • Restore riparian vegetation in degraded areas • Adjust riparian vegetation to favor species that are better suited for future climate conditions
Prevent invasion of non-native fish	Prevent non-native fish invasion	• Strategically use physical or electrical barriers to prevent further spread of non-native fish • Model future changes in stream flow and habitat to anticipate future invasion hotspots • Restore spawning habitats for native fish • Connect current native populations with streams that are too cold for non-native fish
	Expand existing native fish populations to increase chances of existing success	• Expand native fish populations in areas where trying to prevent invasion of non-native fish
Protect climate refugia	Identify and protect areas likely to remain climatically suitable over the long term	• Establish large-scale reserves for long-term native cold-water fish conservation • Connect current populations with streams that are currently too cold (and may warm to suitable levels in the future) • Look for opportunities for reintroductions in habitats likely to remain suitable over the long-term • Understand and map where groundwater inputs may buffer projected stream temperature increases
	Protect and restore critical or unique habitats that buffer survival during vulnerable periods (i.e., seasonally or at particular life history stages)	• Protect/restore off-channel habitats, spring brooks, and seeps important as early rearing environments • Protect/restore flood or thermal refugia and stream segments that are important as overwintering

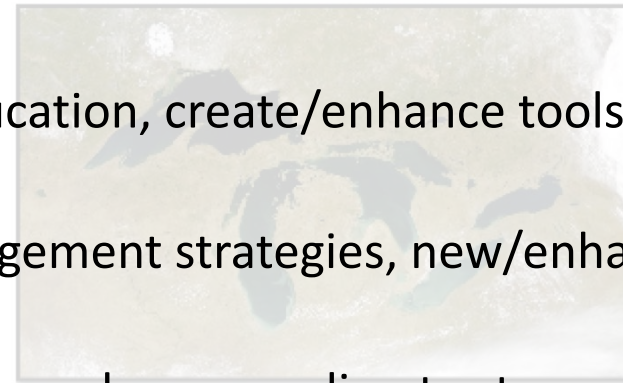




## The State of Climate Adaptation in Water Resources Management: Southeastern United States and U.S. Caribbean



## The State of Climate Change Adaptation in the Great Lakes Region



Rachel M. Gregg, Kirsten M. Feifel, Jessi M. Kershner, and Jessica L. Hitt

October 2012

### **Capacity building**

Reform institutions, research, training/planning, public education, create/enhance tools, monitoring

### **Policy**

Adaptation plans, drought mitigation plans, adaptive management strategies, new/enhanced policies

### **Natural Resource Management and Conservation**

Enhance areas under protection, restore critical ecosystems, reduce non-climate stressors likely to interact with climate, reduce local climate change

### **Infrastructure, Planning and Development**

Resistant/resilient infrastructure, community planning, create/modify development measures, disaster preparedness (plans and policies)



# Preparing water utilities for flood & drought



2017

Rachel M. Gregg, Whitney Reynier, Alessandra Score, and Laura Hilberg

## Changing precipitation patterns (flood/drought), subsidence

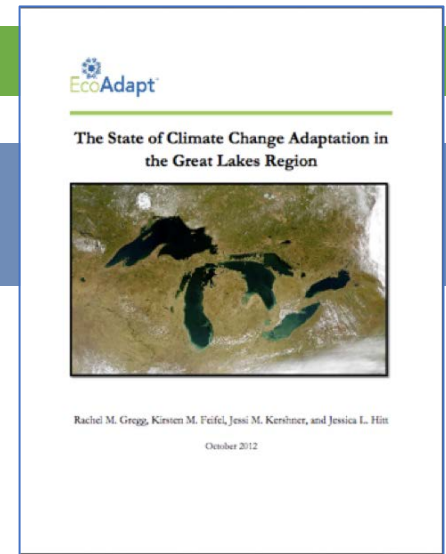
### Actions

- Rebuilding and refurbishing dams to better withstand 100 year storm events
- Increased water conservation programs to reduce consumer overuse
- Watershed health programs to apply land management best practices





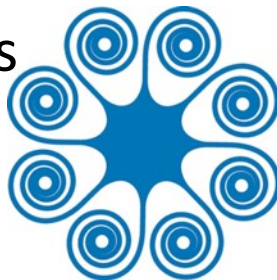
# State Water Plan: Illinois State Water Survey



## Drought, Lack of Management Coordination

### Actions

- Evaluate ability of existing water facilities to cope with drought
- Build historic and projected climate data into water supply scenarios for infrastructure design and function
- Increased dialogue and coordination across state water planning activities
- Cumulative impacts of use and management response strategies on water resources



# Installing beaver mimicry structures



**Decreased late summer flows, increased stream temperatures**

## Actions

- Identify high-flow potential basins resilient to climate change (i.e., temperature and discharge)
- Prioritize high-flow basins for whole-system restoration
- Install beaver mimicry structures as primary restoration approach





Interested in Adaptation? Some resources and opportunities for you!



4<sup>th</sup> National Adaptation Forum  
April 2019 - Madison, WI  
**NationalAdaptationForum.org**



Climate Adaptation Knowledge Exchange  
Your online adaptation destination  
**www.CAKEx.org**



## **Can you identify the elements of adaptation in the vignettes?**

1. What is the vulnerability?

How is climate change affecting the system?

2. What is the adaptation strategy?

Which of the Three Rs (Resistance, Resilience, Response)?

3. How are they addressing it?

Which of the Five Tenets?

4. How will they know if it's working?

What is being monitored? How could it be modified?

